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Editorial introduction: Social and spatial inequalities in health and mortality: The analysis of longitudinal register data from selected European countries

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Abstract

Health inequalities—systematic differences in health outcomes between social groups and across spatial units—are ubiquitous, but not necessarily inevitable. They are the product of a complex interplay of social and economic processes operating at various scales. The unequal pattern of infection and death seen in the Covid-19 pandemic has served to highlight the stark social gradient in health that exists within many European countries. Although the complex social determinants of health have been studied for many decades, there is still a great deal of work to do to elucidate explanations for health inequalities across time and space. To rise to the challenge, we need high-quality, representative data capable of capturing multi-scalar longitudinal processes. This special issue brings together eight new studies which all use national population register data linked with various other sources of administrative data (e.g., residence, tax and health records) to investigate different vectors of inequalities in health and mortality, covering spatial, socioeconomic, ethnic and migrant status. This editorial outlines their contributions, argues for the invaluable role of population register data to understand health inequalities and suggests promising future research avenues.

KEYWORDS
Europe, health geography, health inequality, longitudinal analysis, register data

1 | INTRODUCTION

Health inequalities are systematic differences in health outcomes that occur between different social groups. Health inequality is not inevitable and can be seen as an injustice reflecting past and present societal processes which structure people and places (Brown et al., 2017; Marmot, 2005). With the adoption of the 2030 Agenda for Sustainable Development, all UN member states pledged to adopt the principle that 'no one will be left behind', which acknowledges the simultaneous desire to improve standards for all and reduce the scale of inequalities between and within groups (United Nations, 2016). Europe, with its diverse mix of cultures, welfare regimes and histories, demonstrates wide cross-country disparities in health outcomes. For example, a man born in 2018 in Finland would expect to live to an average of 79 years, some 14 years longer than a man born in the neighbouring Karelian Republic in Russia (United Nations, 2019).

There are also vast spatial and socioeconomic inequalities within societies. For example, a recent report showed that women

living in the most deprived areas of England spent more than one third (34%) of their life in poor health compared with 18% living in the least deprived areas (Marmot, 2020). Moreover, there is recent evidence that health inequalities in some regions are being further exacerbated over time, with those in the bottom of the socioeconomic scale suffering declines in life expectancy (Mackenbach, 2020; Marmot, 2020). Far from being a 'great leveller', the Covid-19 pandemic has laid bare the social gradient in health, and studies in the United Kingdom and Sweden have shown that Covid-19 infections, and death rates are higher among individuals with lower socioeconomic status and who come from migrant or minority ethnic backgrounds (de Lusignan et al., 2020; Drefahl et al., 2020; Williamson et al., 2020). The impact of Covid-19 can only be understood by considering intersecting inequalities at various levels including the household and local geographical area (Kulu & Dorey, 2021). These dimensions intersect with, and are reinforced by, inequalities at other scales such as environment and life course processes.

Public and political awareness of these societal injustices is improving. But crucially, in order to 'leave no one behind' and practically address these issues, we need better evidence to understand the complex interlocking processes involved in producing such disparities across social space and between social groups. This timely special issue addresses the extent and potential causes of health and mortality inequalities within and between European countries, focussing on three key dimensions: spatial, socioeconomic and ethnicity or migrant status. A nuanced consideration of these disparities requires high-quality representative longitudinal data.

The eight papers in this special issue make use of a rich resource available in Europe: individual-level population register data. The studies showcase register data from Sweden, Finland, Belgium, Lithuania and the constituent countries of the United Kingdom: England, Wales, Scotland and Northern Ireland. As the use of digital trace data in the social sciences accelerates (Cesare et al., 2018), the original 'big data'—that of routinely collected administrative data grows more valuable every year, as new linkages become possible and the data are made accessible to more researchers. Register data can be linked at the individual level to other many different sources of data such as healthcare and prescribing data, tax records, housing, census and education records. These data have several advantages over other sources of observational data for studying health inequalities including a larger sample size which provides greater precision, important when studying minority groups or rare health outcomes. Register data are often available over long timeframes, ideal for studying patterns of disease which develop gradually, for studying life course processes and for disentangling causal processes using longitudinal modelling.

In addition, administrative data are likely to capture a more complete picture of the population under study and do not suffer from attrition bias. Clinical diagnosis of health conditions, contact with healthcare services and prescribing/dispensing leave traces in electronic health records, and these can be used to study a range of physical and mental health conditions with a great deal of objective precision, reducing the risk of measurement error from self-reports. Register data may also provide detailed mortality records, especially in high-income countries of Europe. Of course, there are known limitations, such as issues of under-/over-sampling of parts of the population, especially when studying migration and mobilities (Monti et al., 2019). Register data may contain a more limited range of social, psychosocial and attitudinal covariates than some surveys, but this can often be partially mitigated by linkage with established surveys and census data.

The first paper in this issue (Wilson et al., 2020) uses data from Finland and Sweden, thus showcasing the comprehensive population register data available from Nordic countries (Sweden, Finland, Denmark and Norway), which provides individual-level information across multiple dimensions of a person's life course (health, fertility and marriage, residence and SES factors) over several decades. For the majority of European countries without such long-established population registers, census data linked to death records, health registers and other administrative data (e.g., educational attainment and tax records) provides a representative data source for studying inequalities longitudinally. The remaining seven articles in this special issue feature census-linked datasets from Lithuania, Belgium and the constituent countries of the United Kingdom.

In the United Kingdom, there are three census-linked large-scale longitudinal studies: the Office for National Statistics Longitudinal Study (ONS LS), Scottish Longitudinal Study (SLS) and the Northern Ireland Longitudinal Study (NILS). The ONS LS is the oldest: it was initiated in 1971, and it contains linked census and vital events data on a 1% sample of the population of England and Wales. The sample was updated at the 1981, 1991, 2001 and 2011 censuses and in registrations of life events such as deaths, births to sample mothers, emigrations and cancer registrations. New LS members enter the study through birth and immigration and existing members leave through emigration or death. The ONS LS now includes records for over 1.1 million individuals (Shelton et al., 2019). The Scottish Longitudinal Study contains linked census and vital events data for a 5% sample of the population of Scotland (Boyle et al., 2009). These data sources include census data from 1991 onwards; vital events data (births, deaths and marriages); information on migration into or out of Scotland; hospital admissions data and education data (Scottish Longitudinal Study Development & Support Unit, 2020). Finally, the Northern Ireland Longitudinal Study is proportionally the largest longitudinal study in the United Kingdom covering 28% of the Northern Ireland population and accounting for approximately 50% of Northern Ireland households (O'Reilly et al., 2012). NILS data are drawn from Health Card Registration data which is then linked to census returns (from 1981 to 2011), vital events (births, deaths and marriages) and migration data (Northern Ireland Statistics and Research Agency, 2020) and has a particular focus on health-related research. There have now been over 250 peer-reviewed publications making use of linked census and mortality data, drawing on the SLS, ONS LS and NILS.

2 | UNDERSTANDING INEQUALITIES IN HEALTH AND MORTALITY

There is a vast literature on health inequalities, excellent summaries of which can be found in focussed reviews (e.g., Lago et al., 2018; Pathirana & Jackson, 2018; Stringhini et al., 2017) or generalised edited books (Bartley, 2017; Graham, 2009). Here, we outline core theoretical schemas, and associated important studies, that help to frame the studies in this special issue.

2.1 | Spatial and socioeconomic inequalities

Analysis of the socioeconomic gradient in health, which are present in almost all societies, has led to a number of explanatory models being developed (Bambra, 2011; Mackenbach, 2012). These include the behavioural/cultural model which emphasises the role of health behaviours; psychosocial models highlighting the role of relative status inequality; macro-social approaches which emphasise the role of social and welfare policy and lifecourse-based explanations which highlight how inequality accumulates over time (Bartley, 2017). Cross-national comparisons of health gradients across diverse behavioural, political and macro-social contexts have thrown up some interesting paradoxes which question these approaches. For example, contrary to expectations, redistributive Nordic welfare regimes, which we might expect to reduce health inequalities through universal health and welfare, have equally high or sometimes greater levels of health inequality than countries with less egalitarian regimes. This has been attributed to greater social mobility producing widening gaps in poor health behaviours (Mackenbach, 2020) and the challenges in reducing relative inequalities when overall health is improving (Mackenbach et al., 2016). Overall, previous studies show we need a holistic, inclusive approach rather than a crudely competitive one which pits explanations against one another. Novel ways of characterising health inequalities, such as lifespan variation, have also revealed new processes of disadvantage (Van Raalte et al., 2018). Studies have shown those in the least advantaged social groups experience the lowest average life expectancy and also display the largest degree of heterogeneity in their age at death, relative to more advantaged groups. Moreover, variability in age at death is increasing over time for the worst off groups (Sasson, 2016; Seaman et al., 2019; Van Raalte et al., 2014), suggesting the possibility of diverging mortality trajectories.

Socioeconomic health divides often intersect with spatial ones. A classical way to discuss spatial variation in health outcomes has been the relative influence of contextual factors (shared culture, localised policies, area deprivation, healthcare and environmental factors) and compositional factors (e.g., features of individuals such as education, income or employment; Diez Roux, 2002). This contrast has helped to elucidate the role of place in health, stimulate discussion about which elements of place are important for different health outcomes, and to theorise and uncover broader structural influences that might be amenable to intervention (Bambra et al., 2019; Pearce, 2015).

Nevertheless, the utility of the dichotomy between context and composition—which developed alongside advances in multilevel modelling—has been questioned, and current perspectives emphasise a relational approach which acknowledges that particular area-level features might lead to concentrations of certain types of individuals through processes like selective migration (Brown et al., 2017).

A classic example of the complexity of spatial, socioeconomic and temporal disadvantage is investigations of the causes of the 'Glasgow Effect'. This term refers to the excess poor health and mortality of people living in Glasgow relative to the rest of the United Kingdom, a health disadvantage which remains even after adjustment for individual socioeconomic, demographic and behavioural factors. A major review of these diverse studies and hypotheses concluded that the Glasgow effect is likely to be the result of a complex combination of spatial clustering of populations, services and environmental 'bads' which condition poor health behaviours (Macdonald et al., 2018; Macintyre et al., 2008); historical and political decisions that left the city more vulnerable to socioeconomic processes such as deindustrialisation; selective migration flows and lagged, life course effects of deprivation (Walsh et al., 2017).

The Glasgow effect debate highlights the multidimensional and multi-scalar nature of socioeconomic factors and how they interact with health (Øversveen et al., 2017). Studies have shown that different measures of socioeconomic status differentially help to account for health disparities, and we need to think broadly about wealth, inequality, poverty and deprivation, and theorise how they influence, and are influenced by, health (Bambra et al., 2019). The investigation into 'fundamental causes' of health inequalities (Link & Phelan, 1995; Phelan et al., 2010) also suggests further work needs to be done into upstream, structural or institutional socioeconomic drivers of health disparities and how they become biologically embedded over the life course. These issues are ripe for investigation using register data, which can bring together various measures of socioeconomic status on the individual, community and structural levels over long time scales.

The case of Glasgow is also part of a wider research stream, which investigates urban–rural differences in health and mortality in industrialised countries. Historical studies support the notion of an 'urban penalty' (Allan et al., 2017): in the late 19th century and early 20th century, mortality rates were significantly higher in urban areas compared to rural villages (Woods, 2003). Recent studies show that significant urban–rural health inequalities also exist in contemporary societies. However, whereas mortality levels increase with the level of urbanisation in Western and Southern Europe (Allan et al., 2017; Di Tanno et al., 2000; Kibele, 2012), research in the United States shows higher mortality and lower life expectancy in rural areas (Kulshreshtha et al., 2014; Spencer et al., 2018). The causes of health and mortality variation across the urban–rural continuum are unclear. Many studies emphasise the important role of compositional factors, suggesting that health varies between places because different people live in different geographical areas. Consequently, the urban–rural gradient, whether positive or negative, may disappear once demographic and socioeconomic characteristics of the population are controlled. Other research

attributes spatial variation to contextual factors, emphasising the significance of an individual's immediate living environment. For example, the 'urban penalty' in Western Europe may be related to increased levels of pollution, crime, life- and work-related stress and reduced levels of green space, which all (also) discourage outdoor activities (Allan et al., 2017; Kibele, 2012). Finally, the relational approach emphasises that selective migrations may play a role as healthy individuals leave areas of poor health (Norman et al., 2005; Wallace & Kulu, 2018). It is, however, unclear whether selective migration accounts for health variation across residential contexts or rather masks existing differences, as healthy individuals may also leave areas with better health and lower mortality (e.g., rural areas in Western Europe).

Most recent studies in Western Europe have supported the positive urban–rural health gradient. Allan et al. (2019) showed a clear urban–rural mortality gradient, with the risk of dying increasing with the level of urbanisation (Allan et al., 2019). However, the exception was London, where mortality levels were lower than anticipated. The study showed that once the models were adjusted to individuals' socioeconomic characteristics, especially occupation and education, the variation across the urban–rural continuum reduced, although the gradient persisted. Interestingly, socioeconomic composition accounted for a greater portion of the urban–rural mortality difference for males than females; the authors suggested that female mortality is more sensitive to living environment, whereas socioeconomic status plays bigger role for males. Relatively low mortality in London was attributed to the impact of selective migration. The healthiest individuals move to London to study and work, whereas those with poor health may leave London for other (urban) areas. Such a double selection would leave London with a population of good health (Allan et al., 2017, 2019). Acknowledging how context and composition are interrelated, other studies have supported the role of selective migration in shaping regional health and mortality inequalities (Norman et al., 2005; Riva et al., 2011).

2.2 | Inequalities relating to migration, mobility and ethnicity

There is a large literature on mortality among immigrants in Europe and other industrialised countries. Research shows that migrants have lower mortality than the native-born population in the country of destination. Low mortality has been reported for immigrants in, for example, Germany, Belgium, France, the Netherlands and the United States (Blue & Fenelon, 2011; Kibele et al., 2008; Makarova et al., 2016; Tarnutzer & Bopp, 2012; Vandenheede et al., 2015; Wallace et al., 2019). Immigrants show low mortality even when they occupy lower socioeconomic and occupational position in host countries (Makarova et al., 2016). A classical example is Mexican immigrants in the United States who are over-represented among semi- and unskilled workers but still have lower mortality than the U.S. non-Hispanic population (Palloni & Arias, 2004). There are several explanations of low immigrant mortality or a migrant mortality advantage (Wallace & Kulu, 2014). Many studies attribute low immigrant mortality to the 'healthy-migrant' effect; that is, people who move from one country to another are healthier than those who do not move. Return migration, part of any migration streams, may also be selective on health; that is, people who become ill are likely to return to their country of origin (Razum et al., 1998). Therefore, the healthiest of the healthy stay; further, immigrants may leave the country before dying, which is known as the 'salmon-bias' effect.

Issues with registration of migration are also considered important. Emigration is often poorly registered by host countries, and migrants who return to their countries of origin may thus remain in the statistics of the host country for years if not longer (Kibele et al., 2008). The undocumented emigration thus leads to the overestimation of the risk of population used to calculate mortality rates (Wallace & Kulu, 2014). Many recent studies have investigated competing explanations. Several studies have shown that although emigration is poorly registered, this does not explain the low migrant mortality (Wallace & Kulu, 2014). Similarly, research reports significant return migration streams among older immigrants; however, it is less clear how health-selective return migration is. For example, Wallace and Kulu (2018) found some health selection; that is, people reporting poor health returned to their countries of origin, but this did not explain away the migrant mortality advantage (Wallace & Kulu, 2018). However, recently, Guillot et al. (2018) have shown that the migrant mortality advantage is reduced once we account for selective return migration, that is, that migrants who return to their countries of origin are more likely to die than those who stay in the countries of origin (Guillot et al., 2018). Still, it remains far from clear whether the migrant mortality advantage is reduced because of health selective return migration or because return migrants often move to low-income countries with poor healthcare provision for elderly.

Although migrants have lower observed mortality rates than natives, they do not always report health advantages. In contrast, many studies show that migrants have poorer self-reported health than natives (Khlat & Guillot, 2017; Vang et al., 2017). This has led to the notion of the 'migrant health-mortality paradox', which states that migrants have poorer health than native-born population but they live longer. The reasons for the paradox are unclear. Most studies use self-reported health, and it is possible that migrants report poorer health because of poor mental health, for example, due to issues with integration and discrimination. It is also likely that they have poorer health than natives but most illnesses they experience are not severe enough to increase their risk of death. And finally, it is indeed possible that migrants have both poor health and high mortality but the latter is not observed because of health selective return migration or the salmon bias effect. These issues remain topical as most studies to date have used data on migrant health and mortality from different sources (Khlat & Guillot, 2017; Vang et al., 2017).

Recent research has also investigated health and mortality of the descendants of migrants. Most studies show that descendants of immigrants do not exhibit a mortality advantage; their mortality levels are similar to those of the majority population, although they may vary across ethnic groups (Guillot et al., 2019; Khlat et al., 2019;

Razum et al., 1998; Tarnutzer & Bopp, 2012). There are several possible mechanisms explaining the patterns; they may also act in combination (Wallace, 2016). Clearly, selection on health cannot play any role, although descendants of immigrants may inherit from their parents personal traits and genetic factors related to (good) health. Similarly, they may learn and maintain healthy behaviour especially related to dietary habits. On the other hand, descendants of immigrants may also have experienced a significant material and social deprivation in their childhood while growing up in an immigrant or/and minority community. Many (although not all) descendant groups have lower educational levels than the host population and have thus experienced less occupational mobility than might be expected. The situation has often been exacerbated by discrimination in the labour market. This all may be in stark contrast to the notion of 'migrant hope' that immigrants maintain all their lives however successful they are (Anson, 2004).

3 | APPLICATIONS OF REGISTER-BASED DATA FOR STUDYING HEALTH INEQUALITIES

In the first paper, Wilson et al. (2020) bring a fresh perspective to the study of spatial variation in health and mortality by exploring regional variations in life expectancy (LE) and life span inequality in Sweden and Finland. Using aggregate data on the whole population over a 25-year period, the study is the first to assess regional inequalities in life expectancy and an innovative new measure of health inequality—lifespan inequality—for these countries, and to compare regional dynamics over time. The paper documents important positive trends in both overall length of life and life span variation but highlights persistent regional inequalities. Despite cultural, geographic and economic similarities between these neighbouring high-income welfare states, mortality trajectories have varied with Finland narrowing the gap in life expectancy between 1990 and 2014 and Sweden making proportionally smaller improvements. There are still considerable gaps between the best and worst performing regions in both countries, which amount to around 2 years LE for women and men in Sweden and 4 years LE difference for men in Finland. Comparison by gender shows that women in Finland have gained more ground in the life expectancy rankings than men: although regional rankings for male LE have remained similar, for female, LE in many Finnish regions has improved more markedly so that by 2014 they had similar or better LE than Swedish regions. The high LE Finnish regions tended to be those with the highest proportions of Swedish speakers, supporting the findings of previous research (Saarela & Finnäs, 2004). Trajectories of life span variation show similar improvements over time and persistent disparities between highest and lowest LE regions over time. As LE has increased, so inequalities in life span have decreased. This highlights that irrespective of Nordic redistributive welfare policies, persistent regional disparities exist, highlighting the need for more studies investigating the drivers using micro-level register data to unpick patterns of internal migration or the cultural factors.

There are persistent mortality inequalities between Eastern and Western European countries (Human Mortality Database, 2020), and these are especially stark for some causes of death such as cardiovascular disease, accidents and suicide (Leon, 2011; Meslé & Vallin, 2017; Saburova et al., 2011). In the next paper, Jasilionis et al. (2020) explore the importance of context and compositional characteristics in explaining disparities in suicide mortality in Lithuania, a global 'suicide hotspot' with substantially higher rates than many of its Baltic (and former Soviet) neighbours. In particular, the paper investigates sub-national, urban–rural patterns and potential explanations for the 'rural suicide disadvantage' in Lithuania. In former Soviet countries, the urban–rural health gradient runs opposite to many Western European countries. The study exploits longitudinal census-linked suicide mortality data covering the entire male Lithuanian population aged 30–64. This unique dataset enables the authors to investigate mortality risk between 2011 and 2017, making use of rich set of covariates at multiple scales: individual-level covariates from the 2011 census; area-level covariates measuring socioeconomic status (SES) factors, deprivation and social cohesion and rural–urban residence and lifetime migration. The results demonstrate that around half of the rural disadvantage was explained by (individual) compositional characteristics such as education, economic activity, marital status and ethnicity. The multilevel modelling approach also demonstrated the significance of contextual factors; the share of people experiencing unemployment, of people with higher education, of non-married males. These factors such as marriage and unemployment are strongly related to proximal drivers of health such as alcohol use in former Soviet settings. The results also highlight the vulnerability of male urban dwellers who may disproportionately suffer from economic upheaval and have differential migration patterns relative to rural dwellers. The study provides important policy implications for Lithuania and other countries facing male suicide epidemics and suggests that greater policy attention to area-level conditions (in addition to individual characteristics) is warranted.

An obvious target for policy makers is so-called 'amenable mortality'—deaths from conditions considered to be preventable through appropriate healthcare intervention. Previous studies using data from England and Wales have found that, contrary to what we might expect in high income countries with high levels of universal healthcare, SES disparities are more acute for amenable causes compared with non-amenable causes, as their prevention and treatment is linked to the 'fundamental causes' of health inequality—factors related to SES attainment, such as resources, knowledge, social capital and status (Mackenbach et al., 2015). In the next paper, McMinn et al. (2020) provide an investigation using census-linked data from Scotland, a country with some of the largest area- and individual-level inequalities in mortality and life span variation in Europe (Popham & Boyle, 2010; Seaman et al., 2019). Making use of the comprehensive data linkage available in the Scottish Longitudinal Study (SLS), and the rich data on socio-economic status available in the census, the authors relate socio-economic disparities to amenable mortality among 35–74 year olds. The results show large relative and absolute SES inequalities, such that men with no education past age 18 had 3.7 times

higher rates of amenable mortality, compared to men with degree level qualifications. However, disparities were higher than this for social class and social connection (household/marital status) and, on some measures, had widened over the 20-year period from 1991 to 2011, which can be attributed to greater improvements or declines at either end of the status hierarchies. The study provides the first exploration of its kind for Scotland and suggests further research is warranted to better understand exactly how such inequalities operate on amenable mortality. What kinds of resource advantages are deployed by better-off groups, and how are these advantages maintained over time?

There is a growing literature on how residential moves across the life course are associated with a range of outcomes including health (Jelleyman & Spencer, 2008; Mikolai et al., 2020; Tønnessen et al., 2016). Residential transitions often occur alongside other transitions (work or education-based) and may influence health outcomes either directly through changes in environmental conditions (e.g., overcrowding, pollution and availability of outdoor space), and area level deprivation, or indirectly through associations with other individual-level dimensions such as family structure, social class and employment. The next paper by Moriarty et al. (2021) specifically addresses the question of how residential and social mobility, measured by upward or downward transitions in housing value, are associated with mental and physical health status. The authors exploit individual-level residential data from the 2001 and 2011 censuses in Northern Ireland and link these to property values. They relate individual-level changes in housing values to long-term physical and mental health conditions using a life course framework. The paper shows that although there was no evidence for beneficial effects of increasing housing values on health, downward shifts among adults aged 25–64 years were associated with poorer mental health or long-term limiting illness/disability, compared with those whose property values were stable or increased. The fact that downward moves were not associated with poorer health among children or adolescents is a positive note and reminds us of how events can have very different effects depending on the stage of the life course. The topic deserves further attention to track the long-term implications of downward social mobility in perceived 'critical' life course stages, that is, childhood and adolescence. More broadly, the study underline the potential policy importance of social protection policies to prevent slides into poverty for people at all stages of the life course.

Interpreting spatial and SES health inequalities requires an appreciation of migration and health selection processes that may operate to influence health gradients over time. In the next paper **Darlington-Pollock and Norman** (Darlington-Pollock & Norman, 2020) address this issue directly, by developing a framework for assessing whether the movement of differently healthy groups between places or SES contributes to changing health gradients. The authors use data from the ONS LS for census years 2001 and 2011 to demonstrate their approach. They apply the well-established counterfactual 'put people back' (PPB) approach to comparing relative measures of health inequality by area deprivation and social class under different scenarios. This approach is validated by comparing the health status of 'movers' and 'stayers' transitioning between the most and least advantaged circumstances, which shows that movers in better health are more likely to be sorted into advantaged areas and those in poorer health are more likely to be sorted into more deprived areas. The overall effect of this selective sorting contributes to widening deprivation-health gradients, thereby exaggerating health inequalities. This paper substantially extends previous work on selective sorting (Norman et al., 2005), highlighting the multi-scalar nature of health inequalities and their measurement (e.g., selection into and out of deprivation quintiles by health at the individual level can influence health gradient estimates at the aggregate level). The paper thus considers the complex interdependencies between mobility, health and deprivation over time, and how individual and aggregate scales are interrelated.

An understanding of selective mobility is crucial for investigating migration-health dynamics. Two complementary papers in this special issue use census-linked data from the United Kingdom to address the proposed 'migrant morbidity-mortality paradox'. In the first of these, Wallace and Darlington-Pollock (2020) directly test the immigrant morbidity-mortality paradox by comparing self-reported limiting long-term illness (LLTI) in the England and Wales census at 1991 and 2001 across immigrant groups with their survival over the subsequent 10- (or 20)-year periods. The large sample from the ONS LS allows an unprecedented level of detailed analysis of these patterns, according to nine different country of birth subgroups and gender. This reveals different morbidity-mortality patterns by country of origin. Compared with the native population, migrants from India, Pakistan, Bangladesh and the Caribbean displayed a higher likelihood of a LLTI yet also showed lower all-cause mortality risks, providing evidence for the morbidity-mortality paradox. However immigrants from other groups (Ireland, United States, New Zealand, Europe, Sub-Saharan Africa and the rest of the World) generally did not display evidence for the morbidity-mortality paradox, having both lower LLTI and mortality compared with the native population. The paper provides the first direct investigation of the morbidity-mortality paradox in a representative population sample, as previous studies have either used subsamples (e.g., Italian men in Australia; Stanaway et al., 2020), or indirectly through compilation of information on health and mortality from different data sources (Khlat & Guillot, 2017; Vang et al., 2017). Importantly, it also revealed how migrant-health effects vary substantially by immigrant sub-group.

In neighbouring Scotland, Cézard et al. (2020) investigate the self-reported health of migrants and their descendants, where it has long been recognised that immigrants experience substantial health and SES advantages over the native population. They use individual-level data from a unique data source—the Scottish Health and Ethnicity Linkage Study (SHELS) study, which links data for all Scottish 2001 Census respondents (4.6 million people, 94% of the whole population) with hospitalisation and mortality records. Like the previous study, the population level dataset allows detailed investigation of disparities among many different ethnic groupings (in this study, 13 ethnic groups) and explores whether disparities might be explained by individual or neighbourhood SES. The results highlight marked health

disparities between ethnic groups: whereas white British, other White and Chinese groups report better self-assessed health and lower rates of LLTI, other ethnic groups are worse off and differences persisted after SES adjustments. Consistent with Wallace and Darlington-Pollock's study, the results also provide further evidence for the health-mortality paradox in one group particularly—the Pakistani and Indian populations resident in Scotland. Both studies use census data to measure health and mortality, suggesting that this is unlikely to be an artefact caused by differing data sources. The precise reasons why this sub-group experiences the paradox are discussed (better survival in South Asian populations once diagnosed with chronic diseases such as diabetes, or biased data on health and mortality due to 'salmon bias') and provide a puzzle for future research to address. An additional innovation was the differentiation by migrant generation, which revealed, consistent with the healthy migrant effect and acculturation hypotheses, immigrants reported better health than their descendants born in the United Kingdom. This points to the need to understand how and why ethnic differentials in health and survival persist across generations or across the life course.

In the final paper, Neels et al. (2021) take up this issue to investigate how migrant mortality differentials may become eroded over time (duration of residence) and space. Drawing on the rich data available from the Belgium 2011 Census linked to tax records and mortality up to 2015, they explore migrant-native differentials and spatial variation in all-cause mortality by duration of residence controlling for age, household composition, activity status, income and housing characteristics. The results show that the migrant mortality advantage is stronger for those who migrated more recently and that migrant mortality only converges to the native population after 30 years of residence. It takes a similar length of time for spatial patterns of migrant mortality to converge to that of natives. The research also pointed to gender differences: spatial convergence was stronger among migrant men than women. The research raises a host of new questions, such as further investigation of the pace of the acculturation in different types of regions and across disease types and causes of death, and a better understanding of the precise proximal determinants of such convergence (which health behaviours, and risk factors might be responsible).

4 | DISCUSSION

This diverse collection convincingly demonstrates the enormous utility and potential of register data to advance our understanding of health inequalities. Further, we encourage investment in the development of population registers, data linkage, harmonisation and in this emerging pandemic situation remote access to make data more accessible to researchers from a range of disciplines.

The interplay between longitudinal migration processes and health is challenging but deserves further exploration. Although we can theorise and partially investigate processes driving immigrant health disparities, we need a better understanding of how these vary and evolve over individual life courses including the importance of healthy migrant effects and how health influences return migrations leading to differential selection processes. To investigate these, there is the need for studies looking simultaneously at populations in countries of origin and destination, which poses challenges in terms of data availability and harmonisation. However, there may be possibilities for greater comparative work, for example, in Europe by combining registers/census data from different countries.

It goes without saying that we need further work on the mechanisms driving processes of health inequality, but these require methods which can take account of complexity at various scales and over time. Approaches emphasising intersectionality—which aim to describe how overlapping vectors of inequality produce systematic disadvantage (Evans, 2019)—offer promise but require more complex data and/or modelling approaches to understand longitudinal intersectional processes. Furthermore, we support further attention to upstream, structural determinants such as political economy, austerity, neoliberalism (Bambra et al., 2019) and structural racism (Bailey et al., 2017), and how these interact with intersectional approaches (Gkiouleka et al., 2018). At the same time, we must not lose sight of how political economy may result in further heterogeneity at regional scales, which is demonstrated by recent research on how economic policy has produced left-behind areas and populations in the rural United States (Kulshreshtha et al., 2014; Spencer et al., 2018). Further, we support calls for a better understanding of how biological processes interact with social ones and how embodiment of inequality occurs (Vineis et al., 2020). This is especially urgent in the context of emerging pandemics, which urge us to think about the complex interaction of chronic health issues with infectious disease transmission processes and how these are socially and spatially patterned.

To conclude, we hope that the eight studies in this special issue have individually and collectively demonstrated how the classical big data in new forms, that is, routinely collected administrative data with novel linkages can significantly advance our understanding of socio-economic, spatial and migrant/ethnic inequalities in health and mortality.

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